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A Twitter-based Recommendation System for MOOCs based on Spatiotemporal Event Detection

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Abstract
Nowadays, students utilize MOOCs (e.g., Coursera, edX) and SNS services (e.g., LINE, Twitter, Facebook, Tumblr) in courses for learning. This paper presents a Twitter-based recommendation system to search and communication, and it is associated with a web page by detecting spatiotemporal events such as opinions, questions, or impressions about courses on Twitter. Through it, users can grasp popular courses or avoid crowded courses referring to time periods while they browse any web pages. Moreover, the system also enables users to communicate with others browsing the similar pages or users' locations about the similar pages. For this, the system extracts relevance between different pages by detecting tweets of each page in each time period with machine learning algorithms and the number of unique Twitter users. Thus, the system presents a ranking of recommended pages, a tag cloud of tweets and a list of tweets which are related to recommended pages to help users obtain the latest information about recommended pages. In this paper, we propose that students utilize the system to enhance interaction among and with others in actual classrooms. This promises to enlarge the learning effects of students and improve the student collaboration.

Keywords: Twitter; MOOC; spatiotemporal events; recommendation; communication
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1 Introduction

With the proliferation of massive open online courses (MOOCs) in e-learning, enormous amounts of various courses from top universities and institutions are freely shared on the Web, such as Coursera[1] and edX[2]. In order to promote the learning effects, students utilize not only MOOCs but also SNS services in courses such as LINE[3], Twitter[4], Facebook[5], and Tumblr[6]. In the real world, students participated in classrooms often share personal opinions, questions, or impressions about courses through location-based SNS services. Several studies have examined the use of SNS in MOOCs (Van Treeck & Ebner, 2013; Liu, McKelroy, Kang, Harron, & Liu, 2016), the findings indicated that the SNS can augment the learning experience by providing an environment to enhance communications. In addition, the SNS provides a space to post personal feelings or reflections of learning in an informal and quick manner. However, there is not enough to provide a summary of SNS data or recommendation for MOOCs based on the spatiotemporal information of SNS data, it is difficult for aggregating the students' opinions about courses. Therefore, it is important to detect the spatiotemporal events such as opinions, questions, or impressions about courses from SNS data, to help users to better understand the courses while they browse course web pages, and to support communications between users with others in classrooms.

[1]https://www.coursera.org/
[2]https://www.edx.org/
[3]https://line.me/en/
[4]https://twitter.com/
[5]https://www.facebook.com/
[6]https://www.tumblr.com

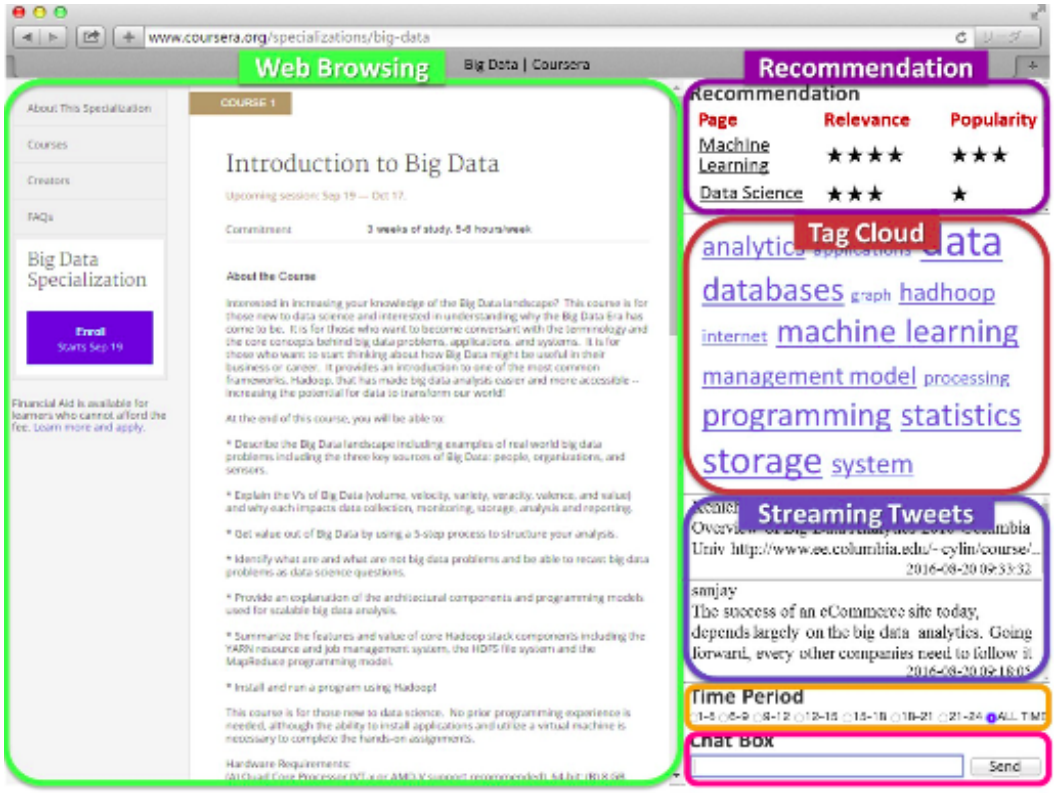

Figure 1: Twitter-based Recommendation System for MOOCs

In this paper, we have developed a novel system for recommending relevant course web pages are associated with the current browsing page based on detected spatiotemporal events. The system can present a quick overview of the latest information about each course web page by extracting feature words from tweets and each course web page. In order to recommend courses, the system can detect relevant course web pages by calculating the similarities between feature words from tweets are related to course web pages. In this system, tweets are posted in actual classrooms can support the communication between online students and Twitter students who attend in actual classrooms. The system has three main features:

1. **Tweet classification**. Detecting related tweets about web pages in different time frames of a day based on the content of tweets and web pages by adopting machine learning algorithms (e.g., k-NN, SVM).

2. **Course recommendation**. Ranking course web pages by calculating the similarities between *TF*-based feature words from tweets about course web pages and counting the number of unique Twitter users who attend in each actual classroom of each page.

3. **User communication**. Utilizing a communication function as TWinChat (Wang et al., 2014) supports web users to chat with Twitter users who attend in actual classrooms of the similar pages.

As depicted in Figure 1, we propose use cases in MOOCs that illustrate how the system can enhance the interaction among and with students in actual classrooms. A ranking of recommended courses to help a user grasp popular courses or avoid crowded courses referring to time periods while the user browses a course page of a MOOC site. Moreover, a tag cloud of tweets and a list of tweets to help the user gain a quick overview and details of the latest information about recommended courses.

2 Twitter-based Recommendation System by Spatio-Temporal Analysis

To use this system, which is on the basis of existing Web services, Twitter users are required to follow an account[7] of our system, as followers of our service, and web users are required to simply install a toolbar (a browser plug-in). Once a user browses a web page with the installed toolbar, the system records the information into a database, which is used for mapping tweets to the web page based on feature words (classroom names) detected from the tweets and the web page, and classifying the tweets of the web page in different time frames of a day by adopting machine learning algorithms. In our system, anonymous of all messages (tweets) can be maintained through Twitter services and a WebSocket server[8]. In our previous work, we acquire a total amount n of tweets based on a given location, and calculate the average frequency of each word i that appears in each tweet t with a standard sigmoid function $1/(1+e^{-x_i})$ for weighting each word i related to location names by the following formulae.

$$\sum_{i=1}^{m}\left(x_i \times \frac{1}{1+e^{-x_i}}\right) \times \frac{1}{m}$$

$$x_i = \frac{\#\text{tweets with } i}{n}$$

The flow of our system is described as follows:

- After a user selects a web page to browse, the system then returns a ranking of recommended pages, a tag cloud of tweets, and a list of tweets are associated with the web page (see Figure 1).
- When the user checks a time period, the ranking of recommended pages, the tag cloud and the list of tweets can be changed by the user's specified time period.
- When the user checks a recommended page, the tag cloud and the list of tweets can be changed by the user's specified recommended page.
- When the user clicks a tag, the system then presents a list of tweets about it, in which most related tweets are presented.
- When the user sends a message through a chat box of our system, the system presents it in the tweet list, Twitter users or other users can receive it.
- When a Twitter user replies the message of the user through Twitter service; the system presents the reply relating to the web page in the tweet list.

3 Use Cases of Utilizing Twitter-based Recommendation System in MOOCs

3.1 Individual Learning

For an individual learning assignment accomplished by searching courses through the MOOC site, there are three interesting use cases.

a. Self-learners can choose courses according to study time based on current situations of actual classrooms.

b. Beginning students can make course plans referring to others' learning experiences on relevant courses.

c. Students are motivated in friendly competition by grasping others' learning progresses in similar courses.

[7] https://Twitter.com/@RtQAService
[8] http://gihyo.jp/dev/feature/01/websocket/0001

3.2 Collaborative Learning

For a collaborative learning assignment accomplished by searching courses through the MOOC site, there are three interesting use cases.

a. Students can share the attending courses through Twitter-based recommendation system.

b. Experienced students can immediately teach or reply beginning students' questions about similar courses.

c. Online students browsing the course web page only, can easily chat with others in actual classrooms.

4 Conclusion and Future Work

In this paper, we propose that online students utilize the Twitter-based recommendation system for MOOCs to enhance the interaction among and with students in actual classrooms. Through it, users can grasp popular courses or avoid crowded courses referring to their study time while they browse course pages. We also stated some use cases of individual learning and collaborative learning through our system. These promise to enlarge the learning effects of students and improve student collaboration.

For future work, we need to improve our tweet classification method by considering the locations of tweets that are not actual classrooms. In addition, we will enhance our system to recommend not only courses but also appropriate users. Furthermore, we plan to expand our system to support not only web pages, but also other learning contents (e.g., lecture slides, lecture videos, etc.).

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